

REMARKS

Applicants have added new claims 79 and 80 to protect additional aspects of the present invention. Claims 22, 26, 48, 70-75, and 78-80 remain pending and under current examination.

Regarding the Office Action:

In the Office Action, the Examiner rejected claims 22, 26, 48, 70-75, and 78 under 35 U.S.C. § 103(a) as being unpatentable over Chen et al. (U.S. Patent No. 5,491,600) (“Chen”) in view of Watanabe et al. (U.S. Patent No. 6,172,859) (“Watanabe”).¹

Rejection of Claims 22, 26, 48, 70-75, and 78 under 35 U.S.C. § 103(a):

Applicants traverse the rejection of independent claim 70 and claims 22, 26, 48, 71-75, and 78 depending from claim 70, under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Watanabe. Applicants respectfully disagree with the Examiner’s arguments and conclusions. A *prima facie* case of obviousness has not been established.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant’s disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). M.P.E.P. § 2142, 8th Ed., Rev. 3 (August 2005), p. 2100-134.

A *prima facie* case of obviousness has not been established because, among other things, neither Chen nor Watanabe, nor their combination, teaches or suggests each and every element of Applicants’ independent claim 70.

¹ The Office Action may contain statements characterizing the related art, case law, and claims. Regardless of whether any such statements are specifically identified herein, Applicants decline to automatically subscribe to any statements in the Office Action.

Independent claim 70 calls for

a pair of bias magnetic field applying films, *each being disposed adjacent to both edge portions of the magnetoresistance effect film*, said each of the bias magnetic field applying films comprising a hard magnetic film containing Co as a structural element; and *an under-layer having a thickness of 5 to 50 nm disposed between the substrate and the hard magnetic film*, the under-layer being composed of *an amorphous layer formed on the main surface of the substrate and a metal crystal layer formed on the amorphous layer*. (emphasis added)

Chen and Watanabe fail to teach or suggest at least these elements of claim 70. The Examiner has admitted that Chen “is silent as to the underlayer having a thickness of 5 to 50 nm and including an amorphous layer and a metal crystal layer formed on the amorphous layer” (Office Action, p. 3). However, the Examiner applied Watanabe in an attempt to cure the deficiencies of Chen.

The Examiner alleged Watanabe “discloses in column 19, lines 23 through column 20, line 18 an *underlayer* having a thickness of 5 to 50 nm and including an amorphous layer and *a metal crystal layer formed on the amorphous layer*” (Office Action, p. 3, emphasis added). An examination of Watanabe, however, shows this to be incorrect. Watanabe fails to cure the deficiencies of Chen as applied to independent claim 70 for several reasons.

Watanabe instead teaches a *longitudinal bias layer* 24, composed of a laminate of a 10 nm Fe-Cr underlayer body-centered cubic (BCC) crystal or amorphous film 252 and a Co-Pt-Cr hard magnetic crystal film 26 (of variable thickness). See Watanabe, Fig. 9, col. 17, line 34 to col. 18, line 21, and col. 19, line 23 to col. 20, line 18. The Examiner only cited Watanabe’s col. 19, line 23 to col. 20, line 18, which discusses the “longitudinal bias layer 24 comprised of a lamination layer including an underlayer of Fe thin film of 10 nm thick and Co-Pt-Cr alloy hard magnetic thin film of 32 nm thick” (col. 19, lines 24-26), where “any other underlayers other than the Fe thin film may be used ... such as ... an amorphous ferromagnetic thin film.” This

can result in either an “amorphous ferromagnetic thin film/hard magnetic thin film lamination” (col. 19, lines 57-58) or a “ferromagnetic thin film with body-centered cubic lattice/hard magnetic thin film lamination” (col. 19, lines 58-60).

It appears that the Examiner focused on Watanabe’s teaching of an amorphous ferromagnetic thin film as an “underlayer” in col. 19. There are several problems with this reasoning, because the laminate longitudinal bias layer 24 does not constitute Applicants’ claimed “*under-layer* having a thickness of 5 to 50 nm disposed *between the substrate and the hard magnetic film*, the under-layer being composed of an *amorphous layer formed on the main surface of the substrate* and a *metal crystal layer formed on the amorphous layer*” (emphasis added).

First, Watanabe also teaches a 40 μm Ni-Fe-Cr alloy thin film as a soft magnetic film 13 and a 20 μm Ta spacer film 14 underneath magnetoresistive effect film 15. These layers also do not constitute Applicants’ claimed “*under-layer* having a thickness of 5 to 50 nm disposed *between the substrate and the hard magnetic film*, the under-layer being composed of an *amorphous layer formed on the main surface of the substrate* and a *metal crystal layer formed on the amorphous layer*” (emphasis added). This is because neither of layers 13 and 14 is amorphous, and because their disclosed film thicknesses of 40 μm and 20 μm , respectively, are orders of magnitude larger than the claimed thickness of 5 to 50 nm.

Second, Watanabe’s ferromagnetic thin film material has a bcc crystal structure, an Fe-Ni alloy, Fe-Co alloy, Fe-Ni-Co alloy, etc., with a preferable underlayer thickness in the range of 5 to 20 nm. See col. 19, lines 33-49. As an amorphous ferromagnetic thin film, Watanabe discloses amorphous ferromagnetic alloys containing Co as the main component, such as Co-Zr-Nb, Co-Zr-Ta, etc. See col. 19, lines 50-56. Thus, Watanabe teaches the use of a

ferromagnetic thin film as an underlayer of the longitudinal bias layer. For example, Watanabe's Fig. 9 illustrates longitudinal bias layer 24 (Co-Pt-Cr hard magnetic film, 32 nm thickness) including an underlayer 252 (Fe thin film, ferromagnetic, bcc crystal structure, 10 nm thickness), *formed on the MR film 15. See also col. 17, lines 31-62.* Thus, Watanabe's teachings do not constitute Applicants' claimed "*under-layer* having a thickness of 5 to 50 nm disposed *between the substrate and the hard magnetic film*, the under-layer being composed of an *amorphous layer formed on the main surface of the substrate* and a *metal crystal layer formed on the amorphous layer*" (emphasis added).

Third, Watanabe's second embodiment (col. 13, line 58 - col. 17, line 30, and Fig. 4) appears to disclose a bias layer 24 formed on a lower gap layer 121, wherein a longitudinal bias layer 24 is composed of an underlayer 252 having a ferromagnetism and bcc structure (*see col. 15, lines 15-23 and Fig. 4*), a Fe-Cr alloy thin film (thickness of 10 nm), and a Co-Pt-Cr hard magnetic film 26 (thickness of 40 nm). However, this also does not constitute Applicants' claimed bias magnetic field applying films having an "*under-layer* having a thickness of 5 to 50 nm ... the under-layer being composed of an *amorphous layer formed on the main surface of the substrate* and a *metal crystal layer formed on the amorphous layer*" (emphasis added).

Furthermore, the Examiner's rationale for combining Chen and Watanabe is improper. The Examiner alleged that "one of ordinary skill in the art at the time the invention was made would have been motivated to substitute a single amorphous underlayer with an amorphous and metal crystal underlayer to suppress Barkhausen [sic] noise" (Office action, p. 3). The Examiner has not shown that one of ordinary skill in the art would have been motivated to combine Chen and Watanabe, viewing only teachings from within these references themselves, in a manner resulting in Applicants' claimed invention.

First, the issue of suppression of Barkhausen noise does not determine whether one of ordinary skill in the art would have been motivated to combine Chen and Watanabe. The respective structures of Chen's and Watanabe's devices do not lend themselves to combination. For example, Chen's bias layer 110 is located outside of, and below, magnetoresistive NiFe film (labeled only "NiFe"). See Chen's Fig. 9. This is quite different from Watanabe's structure, in which laminate longitudinal bias layer 24 is located above magnetoresistive film 15. See Watanabe's Fig. 9. In addition, Chen's Au layers 130 and 150 are positioned between multiple refractory Ta layers on the sides of magnetoresistive NiFe film. This is different from Watanabe's structure, where Au electrode films 17 are formed above magnetoresistive film 15 and above laminate longitudinal bias layer 24.

Second, regarding nonferromagnetic thin films, such as Cr, Watanabe discloses

[w]hen a non-magnetic thin film such as Cr is used as a underlayer, as indicated in FIG. 15, a magnetic field derived from the hard magnetic thin film is recirculated through the ferromagnetic thin film which constitutes MR element below the hard magnetic thin film, thereby, a direction of magnetization in the magnetization sensing area of the magnetoresistive effect film and a direction of magnetization in areas other than the sensing area thereof become oriented in opposite directions from each other. [*thereby causing Barkhausen noise.*] See col. 20, line 57 - col. 21, line 10.

Watanabe therefore teaches use of a non-ferromagnetic thin film, such as Cr, as an underlayer, which clearly does not serve to suppress the occurrence of Barkhausen noise in an MR device, contrary to the present invention.

Furthermore, the Examiner has not shown that one of ordinary skill in the art, when considering Chen and Watanabe, and not having the benefit of Applicants' disclosure, would have been motivated to modify and/or combine these references in a manner resulting in Applicants' claimed invention. The Examiner generally alleged that "[i]t would have been

obvious ... to substitute the underlayer of Chen et al with the underlayer taught by Watanabe et al” (Office Action, p. 3). The Examiner’s allegation is specious at best, and does not explain how one of ordinary skill in the art would have modified Chen and Watanabe to produce all the elements of independent claim 70. The Examiner provides no evidence, beyond general allegations that one would have been motivated to suppress Barkhausen noise, in an attempt to show that one of ordinary skill in the art would have been motivated to combine or modify these references to produce the claimed invention. The clear differences in the structures of Chen and Watanabe demonstrate that they are not combinable, and that the suppression of Barkhausen noise is not determinative of whether one of ordinary skill in the art would have been motivated to combine them.

Applicants respectfully direct the Examiner’s attention to M.P.E.P. § 2143.01, which makes clear that: “[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination” (citations omitted). The Examiner has not shown that Chen or Watanabe “suggests the desirability” of the combination of their very different magnetoresistive device structures, whether or not Barkhausen noise is suppressed. Thus, there would have been no motivation to combine these references. For at least these additional reasons, *prima facie* obviousness has not been established regarding independent claim 70.

Therefore, *prima facie* obviousness has not been established because Chen and Watanabe do not teach or suggest each and every element of independent claim 70, and because the requisite motivation to modify Chen and Watanabe, from within the references themselves, is lacking. Independent claim 70 is therefore allowable, for the reasons argued above, and dependent claims 22, 26, 48, 71-75, and 78 are also allowable at least by virtue of their

dependence from allowable base claim 70. Therefore, Applicants request that the improper 35 U.S.C. § 103(a) rejection be withdrawn.

Conclusion:

In view of the foregoing, Applicants request reconsideration of the application and withdrawal of the rejections. Pending claims 22, 26, 48, 70-75, and 78-80 are in condition for allowance, and Applicants request a favorable action.

If there are any remaining issues or misunderstandings, Applicants request the Examiner telephone the undersigned representative to discuss them.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Dated: January 5, 2006

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